Series 942

How To Use Data Communications with the Watlow Series 942

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Watlow Controls

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How to Use Data Communications with the Watlow Series 942

This manual is a supplement to the Series 942 User's Manual. It is for users with the data communications option. Use in conjunction with the Series 942 User's Manual.

This is expert user-level material and requires previous experience with data communications.

Two Serial Hardware Interfaces and Two Software Protocols

Depending on your units model number, you may have one of two hardware interfaces:

1)**RS-422A** for a "multidrop" or (multiple device) network, up to ten devices total; with 4000 ft. network length limit, or **RS-423A** (RS-232C compatible) for one on one communication on a 50 ft. network with a 942 and a host computer (945A-XXXX--**B**000). They are user selectable via internal switches. See Page 7.

2)**EIA-485** (945A-XXXX-**D**000) also for a multidrop network, up to 32 addresses total, and with a 4000 ft. network length limit.

There are two protocols available to you. Depending on the type of network you need, you must use the correct combination of interface and protocol.

We use **ANSI X3.28 Protocol**, based on ANSI X3.28 - 1976 Subcategories 2.2, and A3, with the RS-422A and EIA-485 interface to run a multiple device network. We also use **XON/XOFF Protocol**, a simpler protocol, to run a two device network with an RS-423A interface. XON/XOFF will also work with the RS-422A and EIA-485 interface, but the network is limited to two devices (one computer or printer and a Series 942). XON/XOFF Protocol requires no responses to messages like the ANSI X3.28 Protocol does. Likewise, ANSI X3.28 Protocol, which provides a response to every message, will work with the RS-423 interface. But again you are limited to one Series 942 and a host computer or printer.

To select which protocol you are going to use, go into the Setup menu and use the MODE key to advance to the **Prot** parameter. Select either **FULL**, for ANSI X3.28 2.2 - A.3, or **On** for XON - XOFF.

If you are using ANSI X3.28 Protocol, choose an address number for the control under the **Addr** parameter following the Prot parameter. This parameter will only appear if Prot = FULL.

Communications Wiring

To connect your Series 942 to a computer, use the next three pages as a reference. Your computer hardware manual will provide more detailed serial port pin information. Also refer to the noise prevention section in Appendix 2 of the Series 942 User's Manual. In the often noisy environments of industrial locations, it is important not to take noise isolation lightly.

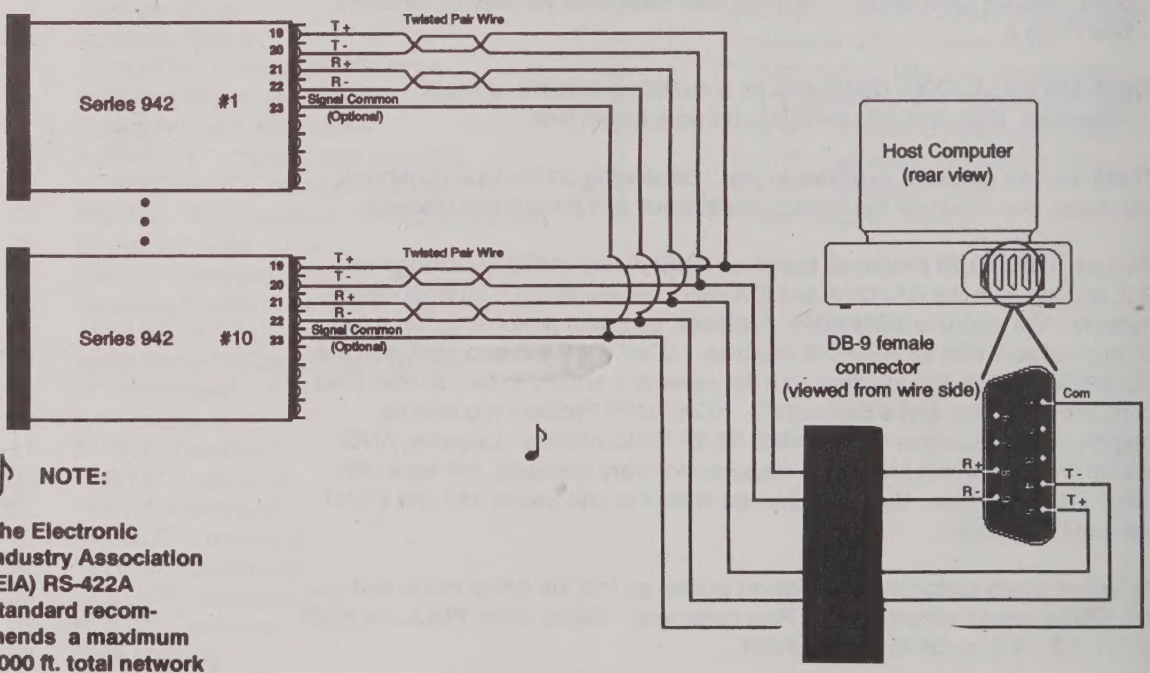
RS-422A Interface Pinouts

942A-XXXX-B000

The RS-422A communications uses a four wire (full duplex) system. There are two separate lines for transmitting, and two lines for receiving data between the computer and the Series 942. With RS-422A you can have from one to ten Series 942 controls connected to a single computer.

This diagram is a **typical** wiring example. The connections on the host computer may vary depending on models. Refer to your computer user's manual for more information.

Figure 1 - RS-422A Interface, Pin Designations.



NOTE:

The Electronic Industry Association (EIA) RS-422A standard recommends a maximum 4000 ft. total network distance.

NOTE:

DB-25 Could be used for DB-9 depending on serial port connector

Burr-Brown Interface
See reference P.7A

RS-423A Interface Pinouts (RS-232C Compatible)

942A-XXXX-B000

The RS-423A communications uses a three wire (full duplex) system. There is a separate line for transmitting, a line for receiving data between the computer and the Series 942, and a line for signal common. With RS-423A you can have only one Series 942 control connected to a single computer.

This diagram is a **typical** wiring example. The connections on the host computer may vary depending on models. Refer to your computer user's manual for more information.

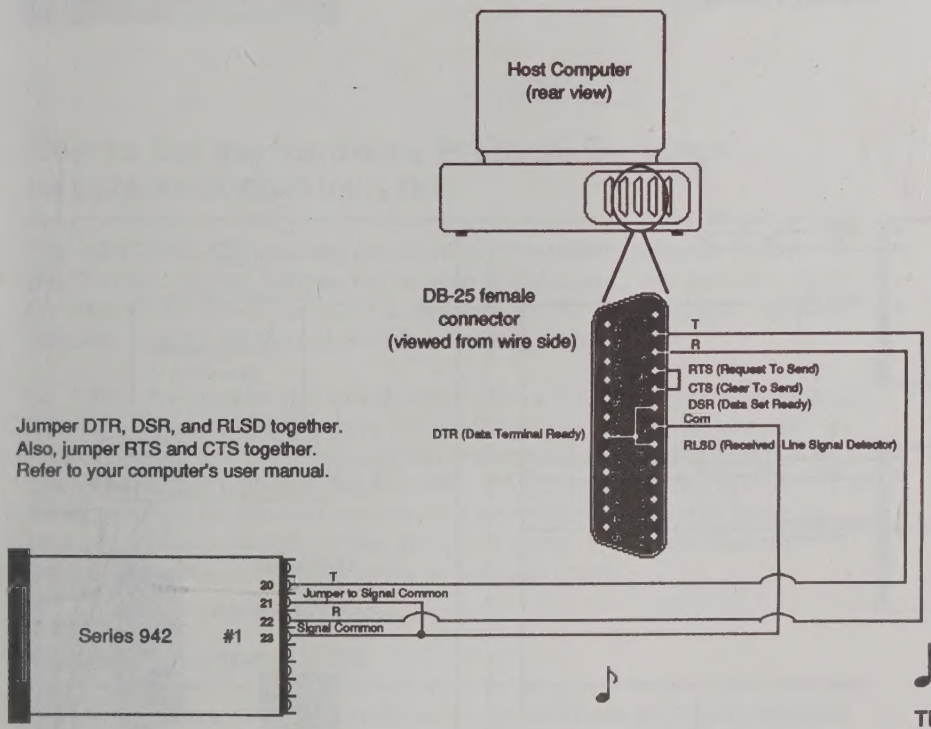


Figure 2 - RS-423A Interface, Pin Designations.

NOTE:

The Electronic Industry Association (EIA) RS-423A standard recommends a maximum 50 foot total point-to-point distance.

NOTE:

DB-9 Could be used for DB-25 depending on serial port connector.

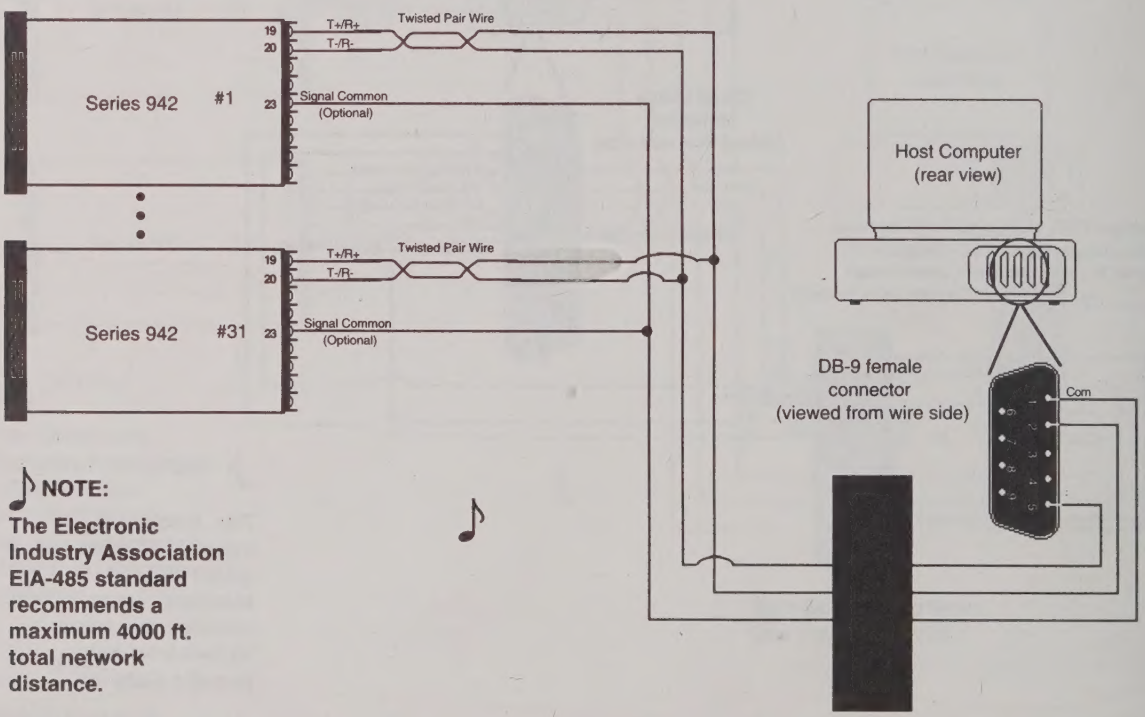
EIA-485 Interface Pinouts

942A-XXXX-D000

The EIA-485 communications uses a two wire (half duplex) system. There are only two lines, both lines used for transmitting and receiving. Only one device, the computer or the control, can be speaking at a time. There is a 5 millisecond delay required for the Series 942 to go between transmission and receipt of data. With EIA-485 you can have from one to thirty-one Series 942 controls connected to a computer.

This diagram is a **typical** wiring example. The connections on the host computer may vary depending on models. Refer to your computer user's manual for more information.

Figure 3 - EIA-485 Interface, Pin Designations.



NOTE:
The Electronic Industry Association EIA-485 standard recommends a maximum 4000 ft. total network distance.

NOTE:
DB-25 Could be used for DB-9 depending on serial port connector

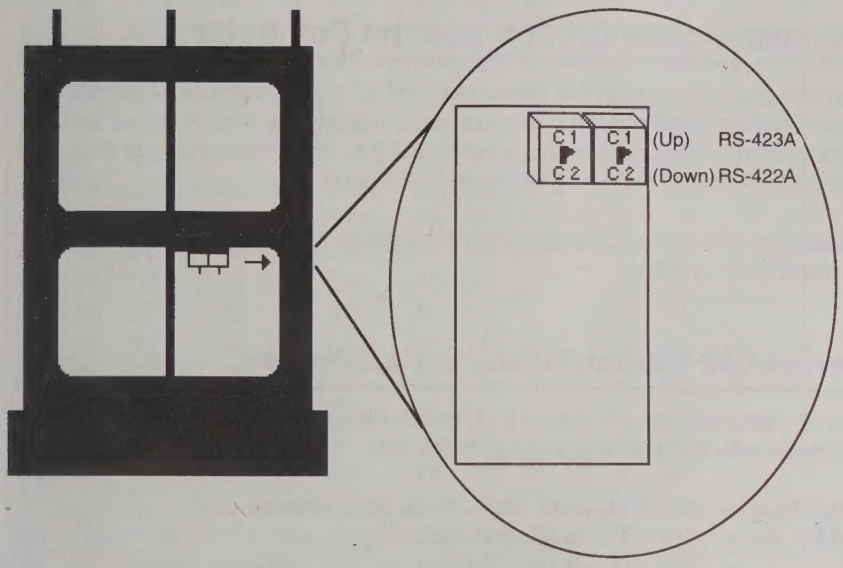


Figure 4 - RS-422A/RS-423A Switch Selection.

NOTE: The Series 942 leaves the factory in RS-423A operation (C1).

How to Set the Hardware Protocol Switches
for 942A-XXXX-B000 Units Only

The RS-422/RS-423 switches are on the Communication Module Board (A007-1830). Figure 4 shows the location of this board. You can select both C1 switches for RS-423 or both C2 switches for RS-422 operation. Both switches must be set the same for the desired protocol.

To change the position of a switch, remove the power from the Series 942 and turn the front panel locking screw 90° counterclockwise. To remove the control chassis, grip the front panel bezel and pull it straight out from the control case. Set both switches the same, C1 (towards you for RS-423) or C2 (away from you for RS-422) then return the control chassis to the case. Be sure it is oriented correctly. Press firmly, but gently, to seat the chassis. Secure the front panel locking screw and reapply power.

Network Connections

You can connect a data communication equipped Series 942 to any computer with an RS-422A or RS-423A (RS-232C compatible) or EIA-485 serial interface. **The serial interface is the key.** The IBM™PC® with an RS-232C serial output card, for instance, will talk to a single RS-423A equipped Series 942. For a multiple 942 network with the same PC, you'll need an RS-232 to RS-422 converter to act as a "bus," or multiple connection point.

A Watlow recommends the Burr-Brown LDM 422 for that purpose. The address is: Burr-Brown, Inc., 1141 West Grant Rd,. Suite 131, Tucson, AZ 85705, Phone: (602) 624-2434, Fax: (602) 623-8965.

B For EIA-485, we recommend the Black Box LD485A. Their address is: Black Box Corporation, Mayview Road at Park Drive, Box 12800, Pittsburgh, PA 15241, Phone: (412) 746-5530.

Connecting the Control and the Computer

Remove power from both the Series 942 and your computer before connecting them together. This prevents noise or static interference from entering the data communication lines. Assemble a cable and the appropriate wiring at your computer. Refer to the wiring on Page 4 through 6.

As soon as you connect the data communications line(s), you're ready to apply power to your system.

Series 942 Communication Parameters

To communicate with the Series 942, match the serial port settings of your computer with the available settings in the 942:

bAUd Rate	=	300, 600, 1200, 2400, 4800, 9600 (choose one)	
dAtA	=	7 o = 7 data bits and odd parity	
		7 E = 7 data bits and even parity	(choose one)
		8 n = 8 data bits and no parity	
Start bit	=	1 (fixed)	
Stop bit	=	1 (fixed)	

The bAUd and dAtA parameters are found under the Setup menu.

ASCII and Series 942 Information

The next page shows you ASCII and control key equivalent tables. Following that, you will find a detailed explanation of the Series 942 syntax and command structure for each of the two protocols.

Communication Software

Watlow has available a communications program for the Series 942 and is IBM-PC® or MS-DOS™ compatible. Ask your Watlow field sales representative for a copy of the "Comm 4" program.

ASCII Character Set

Dec	Hex	Char	Dec	Hex	Char	Dec	Hex	Char	Dec	Hex	Char
00	00	NUL	16	10	DLE	32	20	SP	48	30	0
01	01	SOH	17	11	DC1	33	21	!	49	31	1
02	02	STX	18	12	DC2	34	22	"	50	32	2
03	03	ETX	19	13	DC3	35	23	#	51	33	3
04	04	EOT	20	14	DC4	36	24	$	52	34	4
05	05	ENQ	21	15	NAK	37	25	%	53	35	5
06	06	ACK	22	16	SYN	38	26	&	54	36	6
07	07	BEL	23	17	ETB	39	27	'	55	37	7
08	08	BS	24	18	CAN	40	28	(	56	38	8
09	09	HT	25	19	EM	41	29	)	57	39	9
10	0A	LF	26	1A	SUB	42	2A	*	58	3A	:
11	0B	VT	27	1B	ESC	43	2B	+	59	3B	;
12	0C	FF	28	1C	FS	44	2C	,	60	3C	<
13	0D	CR	29	1D	GS	45	2D	-	61	3D	=
14	0E	SO	30	1E	RS	46	2E	.	62	3E	>
15	0F	SI	31	1F	US	47	2F	/	63	3F	?

Dec	Hex	Char	Dec	Hex	Char	Dec	Hex	Char	Dec	Hex	Char
64	40	@	80	50	P	96	60	`	112	70	p
65	41	A	81	51	Q	97	61	a	113	71	q
66	42	B	82	52	R	98	62	b	114	72	r
67	43	C	83	53	S	99	63	c	115	73	s
68	44	D	84	54	T	100	64	d	116	74	t
69	45	E	85	55	U	101	65	e	117	75	u
70	46	F	86	56	V	102	66	f	118	76	v
71	47	G	87	57	W	103	67	g	119	77	w
72	48	H	88	58	X	104	68	h	120	78	x
73	49	I	89	59	Y	105	69	i	121	79	y
74	4A	J	90	5A	Z	106	6A	j	122	7A	z
75	4B	K	91	5B	[	107	6B	k	123	7B	{
76	4C	L	92	5C	\	108	6C	l	124	7C	|
77	4D	M	93	5D	]	109	6D	m	125	7D	}
78	4E	N	94	5E	^	110	6E	n	126	7E	~
79	4F	O	95	5F	_	111	6F	o	127	7F	DEL

Table 1 - ASCII Character Set

ASCII Control Characters (Partial Set)

ASCII Char.	Ctrl Key Equiv.	Definition	Dec. Equiv.	Hex. Equiv.
ENQ	Ctrl E	Enquiry	5	05
ACK	Ctrl F	Acknowledge	6	06
NAK	Ctrl U	Neg. Acknowledge	21	15
STX	Ctrl B	Start of Text	2	02
ETX	Ctrl C	End of Text	3	03
EOT	Ctrl D	End of Transmission	4	04
DLE	Ctrl P	Data Link Escape	16	10
CR	Ctrl M	Carriage Return	13	0D
DC1	Ctrl Q	XON	17	11
DC3	Ctrl S	XOFF	19	13

Table 2 - ASCII Control Characters (Partial Set)

Series 945 General Message Syntax

As soon as you link the devices, you'll be able to talk to the Series 942 using ASCII characters.

The Series 942 will respond to any operating or set up parameter, plus some others. The control will respond to either upper or lower case ASCII characters from your computer.

Both protocol/interface combinations will respond to the general syntax, providing the commands or queries are correctly transmitted. However, the ANSI X3.28 Protocol requires beginning and ending characters, and the XON/XOFF Protocol requires ending characters. We'll look at those shortly.

Message Syntax

Messages from your computer to the Series 942 must take this general form. All commands do not require the full number of data fields.

Command <Space> Data.1 <Space> Data.2 <Space> Data.3... Data.N

"Command" is a character set to which the Series 942 will respond. The brackets "< >" enclose a non-literal description. "Space" is simply a delimiter, an ASCII space character (Hex 20). "Data Fields" are parameters and values specific to a command; the number of possible data fields depends on the particular command you use. Data 1 is here abbreviated, "Data.1", Data 2 is "Data.2" and so on.

In the syntax explanations ahead, we'll show you the specific arguments for each command. It will speed the process, if you remember this general syntax.

Data Rules

Data fields are parameters and values specific to particular commands. These rules govern their use. Specific data for each command is listed later in this chapter.

- Data will be ASCII 0 through 9, unless otherwise noted.
- Data can go up to seven total characters, including a minus sign. A + or - sign, if used, must be first, and it must have a decimal point if applicable.
- Data can use leading zeros. (Up to 7 digits.)
- Data does use decimal points.
- Data.1 portion of message can be up to four total characters.

Command List

These commands, represented by their respective ASCII characters, will enable you to program the Series 942 from your computer. More detailed descriptions of the commands are on the pages noted.

?	Finds the value of a specific parameter.	p. 18
=	Sets a specific parameter to a specific value.	p. 19

Example Format

For your benefit, we're presenting message/response examples with syntax required for Series 942 communication. Information bracketed by < > indicates a description, rather than literal characters. We show each ASCII character that you must transmit to the Series 942, including space between the characters. (A "space" is itself an ASCII character, hex 20). For clarity, we also represent each ASCII character as a hexadecimal pair. The pairs are spread apart on the page for easy reading. However, electronic devices "see" the hex pairs all together in "strings," with no spaces in between.

For instance, from the example just below, you want to set the Alarm 1 Low (A1LO) parameter to 500°. Notice the syntax just below which uses the "=" command.

= <Space> A1LO <Space> 500

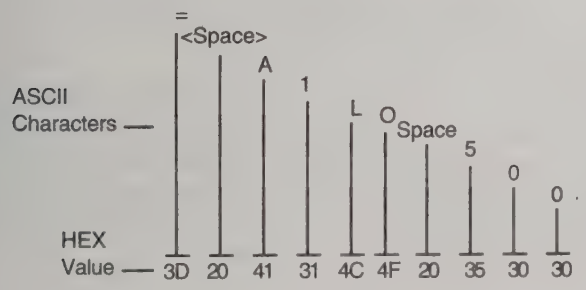


Figure 5 - Series 942 General Message Syntax Example.

To send the message on Page 11, Figure 5, you key the ASCII characters into your computer, or write them into your program. The computer, in turn, will send a string similar to the one at the bottom of the example, 3D2041314C4F20353030.

Notice that we haven't mentioned protocol here, or any characters added to this syntax by a protocol. With XON/XOFF, the message above can be transmitted with only an additional Carriage Return <CR> (hex 0D) character at the end. However, the ANSI X3.28 Protocol requires an envelope of Start of Text <STX> (hex 02) and End of Text <ETX> (hex 03) characters around the information you see above. You'll learn how to do that in the pages ahead.

XON/XOFF Protocol for RS-423A

XON/XOFF (flow control) Protocol allows a communicating device (either a 942 or the host) to suspend transmission of all messages from the other device, and then to continue transmission when it's again ready.

The device that needs to suspend transmission sends the XOFF character (hex 13) to stop the other device's transmitter, and XON (hex 11) to restart it. Note that technically any character will restart the transmitter, but only the XON character is not a part of any regular message that may be transferring.

Messages transmit according to the syntax described in the XON/XOFF formats which follow for each command.

The XON/XOFF Protocol requires a Carriage Return character (hex 0D) at the end of every message.

How To Start and Stop Communicating with the Series 942 and XON/XOFF

Starting communications with **XON/XOFF Protocol** is simple. You just configure your computer to agree with the Series 942 communication parameters and open its serial communication port in software. Then begin to "talk" by transmitting a message to the Series 942. You stop communicating with XON/XOFF Protocol simply by ceasing to send messages.

XON/XOFF "=" Command Example

The general command syntax is the one you've already seen. Each command uses a slightly different variation of it, depending on the number of arguments required for a message.

• You want to change the Alarm 1 Low (A1LO) value to 500°. The "=" Command will do the job.

The syntax with XON/XOFF Protocol requires an ending Carriage Return <CR>.

"=" Command Syntax with XON/XOFF Protocol:
= <space> Data.1 <space> Data.2 <CR>

With the "=" Command, Data.1 is the Series 942 parameter, in this case Alarm 1 Low, A1LO. Data.2 is the value you want to set for that parameter, in this example, 500.

Enter in ASCII:
= <space> A1LO <space> 500 <CR>
The hex string will be:
3D2041314C4F203530300D

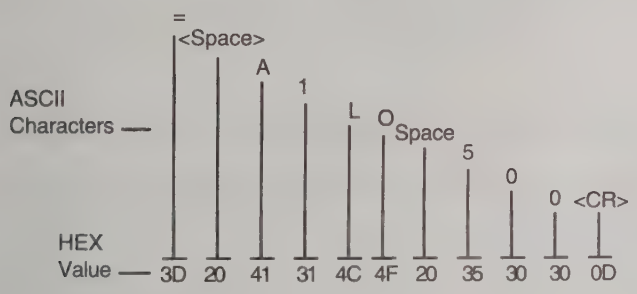
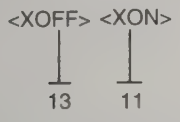


Figure 6 - XON/XOFF "=" Command Example.

Response from the Series 942:
It sends an "XOFF" when a carriage return is received and then an "XON" when the unit is done processing the command.



• The complete list of "=" Command data (parameters and value limits) is in Table 5, Pages 19 - 21.

XON/XOFF "?" Command Example

You want to know the Alarm 1 Low (A1LO) value. The "?" uses a variation of the message syntax shown just below. **This protocol requires an ending carriage return character.**

"?" Command syntax with XON/XOFF Protocol:
? <space> Data.1 <CR>

Enter in ASCII:
? <space> A1LO <CR>
The hex string will be:
3F2041314C4F0D

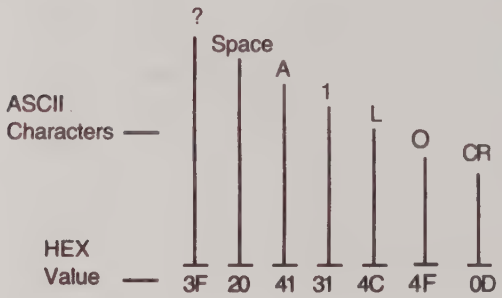


Figure 7 - XON/XOFF "?" Command Example.

The value of A1LO will be between rL (Range Low) and rH (Range High), say, 500.

Response from the Series 942:
<XOFF> <XON> <current value of A1LO> <CR>

The hex response string is:
13113530300D

ANSI X3.28 Protocol for RS-422A and EIA-485

The ANSI X3.28 Protocol provides high quality communications by requiring a response to every message. With a multiple device or "multidrop" network, this protocol prevents confusion among the separate devices. Furthermore, if noise occurs somewhere in the system, no parameter will change because noise can't comply with the protocol.

By placing messages inside a protocol envelope, the messages are protected. In the examples to come you'll see how this works.

The ANSI X3.28 Protocol requires STX characters at the beginning of a message and ETX characters at the end.

Device Address

If you are using the ANSI X3.28 Protocol, you must have a device address (identification) number. A Watlow RS-422A multidrop network can handle up to 10 devices with this protocol. EIA-485 can handle up to 32 devices. Set the address number with the Series 942 in the **Addr** parameter under the Setup menu.

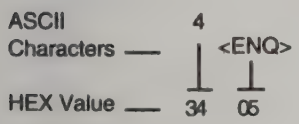
Address	ASCII Equivalent
0 - 9	0 - 9
10 - 31	A - V

Table 3 - Address to ASCII Conversion.

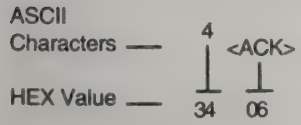
Starting Communications in ANSI X3.28 Protocol

Here's the syntax for starting communications with ANSI X3.28 Protocol. The master device, your computer, must initiate the data link. The example below uses the ASCII number 4 as a Series 942 device address.

Enter in ASCII, using this syntax: <Address # 4><ENQ>



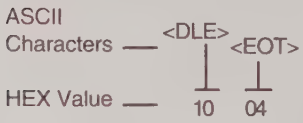
Response from the 942:
<Address # 4><Acknowledge (ACK)>



Stopping Communications in ANSI X3.28 Protocol

The master device, your computer, must end communications with Device #4 by using Data Link Escape (DLE) and End of Transmission (EOT) characters.

Enter in ASCII: <DLE><EOT>



Response from the 942:
None

ANSI X3.28 "=" Command Example

The "=" Command sets a specific 942 parameter to a specific value. The general command syntax applies to all commands. The definition and number of arguments depends on the command itself. See Table 5, Pages 19 - 21.

In this example, you want to change the Alarm 1 Low value to 500°. Here, the "=" Command will do the job.

"=" Command Syntax with ANSI X3.28 Protocol:
<STX> = <space> Data.1 <space> Data.2 <ETX>

With the "=" Command, Data.1 is the Series 942 parameter, in this case Alarm 1 Low , A1LO. Data.2 is the value you want to set for that parameter, in this example, 500.

Enter in ASCII:
<STX> = <space> A1LO <space> 500 <optional carriage return> <ETX>
The hex string is:
023D2041314C4F2035303003

Figure 8 - ANSI X3.28 "=" Command Example.

Response from the Series 942:
<ACK>
The hex response string is:
06

• You'll find the the complete list of "=" Command arguments (parameters and value limits) in Table 5, Pages 19 - 21.

ANSI X3.28 "?" Command Example

You need to know the Alarm 1 Low value (A1LO). The "?" uses a variation of the message syntax shown just below. **This syntax requires the protocol start of text and end of text characters.**

"?" Command syntax with ANSI X3.28 Protocol:
<STX> ?<space> <Data.1> <ETX>

Enter in ASCII:
<STX> ? <space> <A1LO> <optional carriage return> <ETX>
The hex string will be:
023F2041314C4F03

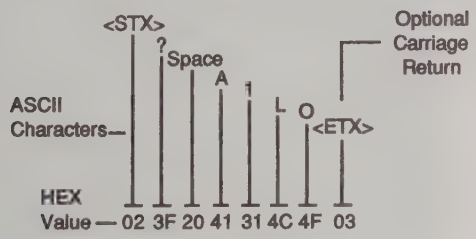


Figure 9 - ANSI X3.28 "?" Command Example.

First response from the Series 942:
<ACK>
The <ACK> hex response string is:
06

Your computer's confirming response:
<EOT>
The <EOT> response hex string is:
04

Second response from the Series 942:
<STX> <current A1LO value> <carriage return> <ETX>
The hex string is:
023530302003

Your computer's next response:
<ACK> or < NAK> (if the message needs to be repeated).
The hex string is:
06 or 15

Final response from the Series 942:
<EOT>
The hex string is:
04

"?" Command

The "?" command finds the specific value of a Series 942 parameter (Data.1). Table 4 and 5 provide the complete list of parameters you may use, plus responses. You may use the "?" command in either the RUN or HOLD modes.

Table 4 - "?" Commands and Responses. These commands are READ ONLY.

The "?" Command reads a specific value of the Series 942 parameter (Data.1).

Data.1	Respns	Information	Comments
BTYP	0 1 2 3	T/C Only T/C, RTD whole, process T/C, RTD tenths, process R, S, B T/C	
C1	PROCESS	Process value	Between RL and RH
CSP	SETPOINT	Current Profile Set point	Between RL and RH
EJC	0 - 100	The # of jumploops remaining.	Run mode only.
ENSP		End Set Point of current step.	Run mode only.
ERR	0 1 2 4 8 16 32 64 128	No error Open sensor Reversed sensor Ambient sensor Configuration EE Checksum A/D underflow A/D overflow Not used	Multiple errors are possible.
ER2	0 1 2 3 4 5 6 7 8 20 21 22 23 24 25 26 27 28 29 30 31 32 33 39	No error Transmit buffer overflow Receive buffer overflow Framing error Overrun error Parity error Talking out of turn Invalid reply error Noise error Command not found Parameter not found Incomplete command line Invalid character Number of chars. overflow Input out of limit Read only command Write allowed only Output 3 is not an event Output 4 is not an event Request to RUN invalid Request to HOLD invalid Command invalid in RUN mode Command invalid in RUN mode Infinite loop error	Cleared when ER2 is read. Only 1 ER2 response is valid.
MDL	See Page 21.	Displays 942 X X = software revision	
MODE	1 2 4 8 16 34	Run mode Hold mode Configuration mode Calibration mode Alarm silence active OFF	Multiple modes are possible.
MTR	See Page 21.	Monitors current step	Run or hold mode.
RESU	See Page 22.	Resume a profile	Hold mode only.

"=" Command

"The "=" command sets a specific Series 942 parameter (Data.1) to a specific value (Data.2) when the unit is in the HOLD mode. Use Tables 4 and 5 to select parameters (Data.1) in the lefthand column. In Table 5 the low and high limit or code values (Data.2) are in the three center columns.

Data.1	Data.2			
	Low Limit	High Limit	Code	Function
AXHI	Process rL value 0 to 999	rH value		Alarm High X value
AXLO	Process RL value ±555/Deviation ±999	RH value		Alarm Low X value
ALM	0 1 2 4 8	No alarms occurring AL1H occurring AL1L occurring AL2H occurring AL2L occurring		Writing a 0 will clear all alarms if the alarm condition no longer exists.
AL1	0	1	0 1	Alarm 1 = deviation Alarm 1 = process
AL2	0	1	0 1	Alarm 2 = deviation Alarm 2 = process
AUT	0	3	0 1 2 3	No auto-tuning Slow response tuning Medium response tuning Fast response tuning
CAL*	-99°F -55°C -55 Units	99°F 55°C 55 Units		Calibration offset
CF	0	1	0 1	Display °C Display °F
CTX	1	60		Output X cycle time
DB	0 0 0 Units	99°F 55°C 99 Units		Dead band
DEC	0	2	0 1 2	No decimal point 0.0 0.00
DEX	0.00	9.99		Output X derivative
DFL	0	1	0 1	US prompts SI prompts
ENTX	0	1	0 1	Event Off Event On
GSD	0 0 0 Units	99°F 55°C 99 Units		Guaranteed Soak Dev.
HYSX	1°F 1°C 1 Unit	99°F 55°C 99 Units		Output X switching hys.
INDC	1	1	1	UP/DOWN key action
INT	0.0	60.0		Time interval in minutes for logging 0.0 = logging OFF

NOTE:
An X means that it applies to either Output 1 /Auxiliary 3 or Output 2/Auxiliary 4.

Table 5 - "=" and "?" Commands. These are READ or WRITE commands. See Table 4 for more "?" Commands.

*** When the 942 RTD input is 0.1°, these parameters will have a decimal point to the left of the least significant digit.**

Table 5 - Continued

Data.1	Data.2			
	Low Limit	High Limit	Code	Function
IN	0	12	0	J T/C
			1	K T/C
			2	T T/C
			3	N T/C
			4	PT2 T/C
			5	C T/C
			6	Not Used
			7	R T/C
			8	S T/C
			9	B T/C
			10	RTD whole
			11	RTD tenths
			12	0-5V
			13	4-20mA
ITX	0.00	9.99		Output X Integral
LATX	0	1	0	Latched alarms
			1	Non-latched alarms
LOC	0	3		Front panel lockout
LOG	0	1	0	Logging OFF
			1	Logging ON
				See Page 21.
OFF	0	1	0	Hold
			1	OFF
OUT	0	3	0	Heat/Cool (output 1 & 2)
			1	Cool/Heat
			2	Heat/no action
			3	Cool/no action
OT3 or 4	0	2 or 4*	0	Alarm
			1	Event
			2	No action
			3*	Process Retransmit
			4*	Set Point Retransmit
				*only applies to Ot4
PBX	0	999°F		Output X
		555°C		Proportional Band
		999 Units		
POUT	0	3	0	Continue
			1	Hold
			2	Abort
			3	Reset
PSTR	0	1	0	Process
			1	Set Point
PTYP	0	1	0	Time Based
			1	Rate Based
RAX	0.00	9.99		Output X Rate
REX	0.00	9.99		Output X Reset
RH	Min. IN range	Max. IN range		Range High
RL	Min. IN range	Max. IN range		Range Low
RTD	0	1	0	DIN
			1	JIS
SIL	0	1	0	Alarm silence OFF
			1	Alarm silence ON
SP1	RL	RH		Set point

Data.1	Data.2			
	Low Limit	High Limit	Code	Function
TAG	0	7	0	- - - = no logging
			1	- - A
			2	- S -
			3	- SA
			4	P - -
			5	P - A
			6	PS -
			7	PSA

Table 5 - Continued

NOTE:
P = Process
S = Set Point
A = Auxiliary Status
- - - = no logging

"? MDL" Command

This command asks the 942 for the type of unit and the level of software. The model number will appear as 1 character. The syntax of the function is as follows:
? <Space> MDL

This function will return the following information:
942<Model number> <Space> <Software revision level>

"? MTR" Command

The ? MTR command monitors the current RUNning step.

The syntax for this command is: **?<Space> MTR**

There are no arguments to the command. The command will return the following data:

<Current Step #> <Space> <Current Step Type> <Space> Data.4 <Space> Data.5 . . .Data.n

Table 6 below shows how to interpret the response syntax. Note that each argument is an ASCII decimal number representing a specific value for each parameter listed in the table. A response would be:

<11> <space> <1> <space> <375> <space> <2> <space> <30> <space> <0> <space> <1> <space> <1>

This tells you that the current step is #11 a Set Point step, the SP is 375°. Step time is 2:30:00, Events 1 and 2 (Ent1, Ent2) are ON.

	PtYP = rAtE	PtYP = tI	Step Type		
	Set Point	Set Point	Soak	Jumploop	End
Step #	<Step#>	<Step#>	<Step#>	<Step#>	<Step#>
Type Code	1	1	2	3	0
Data.2	<SP>	<SP>	<HOUr>	<JS>	<End>
Data.3	<rAtE>	<HOUR>	<min>	<JC>	
Data.4	<Ent1>	<MIN>	<SEC>		
Data.5	<Ent2>	<SEC>	<Ent1>		
Data.6		<Ent1>	<Ent2>		
Data.7		<Ent2>			

Table 6 - "? MTR" Command Response Data. < > = Non-literal Description.

"? STP" Command

The "? STP" command reads a given step in the Series 942 program space (24 steps total).

The syntax for this command is:
?<Space> STP <Space> <Step #>

The command will return the following information:
<Step#> <Space> <Step Type> <Space> Data.2 <Space> Data.3 ... Data.n

Table 7 below shows how to interpret the response syntax. Note that each argument is an ASCII decimal number representing a specific value for each parameter listed in the table.

A response for Step# 8 would be:
<8> <space> <1> <Space> <235> <space> <1> <space> <20> <space> <15> <space> <1> <space> <0>

This tells you that Step# 8 is a Set Point step, SP is 235°. Step time is 1:20:15, Ent1 is ON and Ent2 is OFF.

Table 7 - "? STP" Command Response Data. <> = Non-literal Description.

	PtYP = rAtE	PtYP = tI	Step Type		
	Set Point	Set Point	Soak	Jumploop	End
Type Code	1	1	2	3	0
Data.2	<SP>	<SP>	<HOUr>	<JS>	<End>
Data.3	<rAtE>	<HOUr>	<min>	<JC>	
Data.4	<Ent1>	<min>	<SEC>		
Data.5	<Ent2>	<SEC>	<Ent1>		
Data.6		<Ent1>	<Ent2>		
Data.7		<Ent2>			

"= HOLD" Command

This command causes the 942 program to HOLD. If the program is already HOLDing, an error will occur.

The syntax for this command (not including protocol characters) is:
= <Space> HOLD <Space> 1

Check the HOLD status with "? MODE."

"= RESU" Command

This command causes a Series 942 program to RESUME. If the program is already RUNning, an error will occur.

The syntax for this command (not including protocol characters) is:
= <Space> RESU <Space> 1

Check the RUN status with "? MODE."

"= STRT" Command

This command causes the 942 program to start. If the program is already RUNning, an error will occur.

The syntax for this command (not including protocol characters) is:
= <Space> STRT <Space> <Step#>

Check the RUN/HOLD status with the "?MODE" command.

"= STP" Command

NOTE:
You may write to a Series 942 step with the "STP" Command only when the unit is in the HOLD mode.

The "= STP" command is used to program a given step in your profile. Remember that total profilespace is 24 steps. You can use the "= STP" command only in the HOLD mode.

The syntax for this command (not including protocol characters) is:
= <Space> STP <space><Step#><space><Step Type Code>
<space><Data.5><space><Data.6><space>...<Data.10>

Table 8 below shows how to interpret the syntax. Note that each data field is an ASCII decimal number representing a specific value for each parameter listed in the table.

A syntax example is Step #16 is a Set Point step, with SP at 255° for 1 hour, 36 minutes, 58 seconds with EV1 ON and EV2 OFF would be:

= <space> <STP> <space> <16> <space> <1> <space> <255> <space> <1> <space> <36> <space> <58> <space> <1> <space> <0>

NOTE:
OFF = 1
Hold = 0

	PtYP = rAtE	PtYP = tI	Step Type		
	Set Point	Set Point	Soak	Jumploop	End
Step #	<Step#>	<Step#>	<Step#>	<Step#>	<Step#>
Type Code	1	1	2	3	0
Data.5	<SP>	<SP>	<HOUr>	<JS>	<End>
Data.6	<rAtE>	<HOUr>	<Min>	<JC>	
Data.7	<Ent1>	<Min>	<SEC>		
Data.8	<Ent2>	<SEC>	<Ent1>		
Data.9		<Ent1>	<Ent2>		
Data.10		<Ent2>			

Table 8 - "=STP" Command Data. <> = Non-literal Description.

Data Logging

The data logging feature is a convenient replacement for chart recorders. Information is sent directly from the Series 942 to a serial printer, or to a computer disk file. **No computer is needed.** Data logging provides a handy reference to review process performance. The time intervals between each entry and the data printed are user selectable, with the time display resetting each 24 hours. The Prot parameter must be On, and your control must have communications for the following parameters to appear.

Log: Selects the data logging function for a printout of the data. This parameter will appear if your 942 has communications, and Prot = On.

Int: Selects the time interval for the logging function. This parameter will appear if your Series 942 has communications, Prot = On, and Log = On. The logging interval is in tenth of a minute increments.

tag: Selects what variables are to be transmitted out during the data logging function. This parameter will appear if your Series 942 has communications, Prot = On, and Log = On. Any combination of process, set point and auxiliaries may be "tagged" for logging.

Figure 10 shows a typical wiring example. The connections on the printer may vary depending on models.

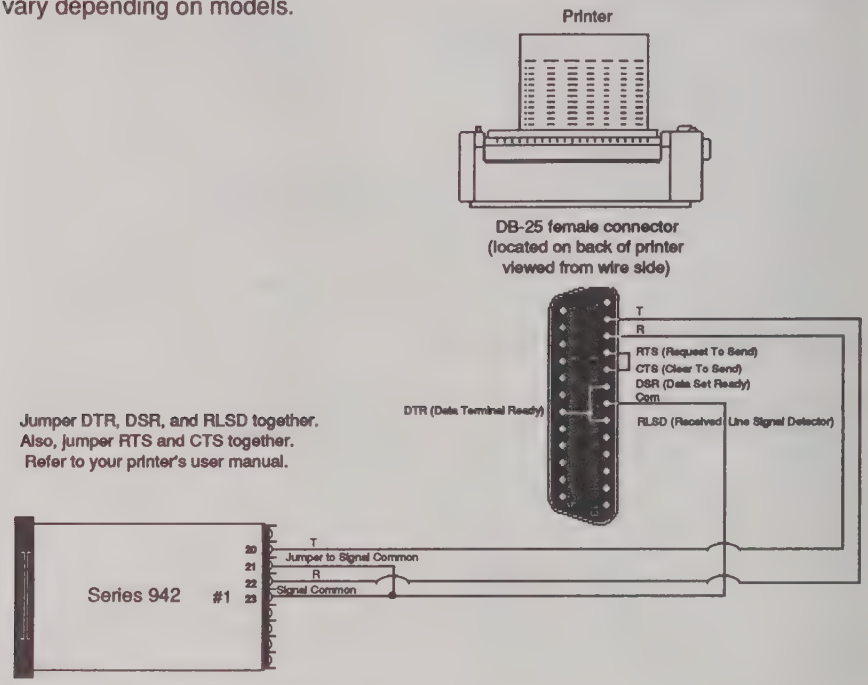


Figure 10 - Data Logging Interface Wiring Example.

Example: Log = On, Int = 0.1, tag = PSA
P = Process
S = Set Points
A = Auxiliary Status
Output 3 is configured as an alarm, and Output 4 is configured as an event.

Parameters represented:

(C1) (SP1) (A1LO) (A1HI) (Ent2)

TIME	PROCESS	SET-1	LOW-1	HIGH-1	Event-2
0.0	80	100	32	1382	1
0.1	81	100	32	1382	1
0.2	81	100	32	1382	1
0.3	82	100	32	1382	1

Figure 11 - Data Logging Printout Example.

After each line the 942 emits a carriage return. Your printer can be set up to handle line feeds. The printer must supply a line feed (LF) following a carriage return (CR). Refer to your printer user's manual for more information.

A data header is printed when the logging function begins. When you change the time interval (Int), any selected data (tag), or power is cycled, the header will be printed again. The time display wraps around to 0.0 every 24 hours.

Data fields emitted are determined by the tag parameters and the control configuration. As in the example above, the tag parameter was set for PSA (**P**rocess, **S**et Points, **A**uxiliary Status).

The 942 can also be connected to a computer with a serial port and terminal emulation software. Logged data can be sent via the terminal program to a disk file.

Problem	Cause	Action
Printing all on the same line.	The line feed is missing.	Set the printer for a carriage return and line feed.
The printing is garbled.	Data formats are not compatible.	1. Match the Series 942 data format to the printers data format using the "Data" prompt. 2. The Baud rate is not set correctly.
The printer will not print.	The printer is off line.	Bring the printer on line.
	The transmit and receive lines are reversed.	Make sure Terminal #20 and #22 go to the printers appropriate receive and transmit terminals.

Table 9 - Printer Troubleshooting.

NAKs and Error Codes

When your message is "not acknowledged" (NAK) in RS-422A or EIA-485 with ANSI X3.28 Protocol, you may clear ER2 code by reading it. That is, use "?"

Then try the message again; you may have made a syntax error. See the error code listing in Table 4, Page 18.

With XON/XOFF protocol and the RS-423A interface, the 942 sends no feedback on commands. Therefore, you may want to query the status of ER 2 after each command you send.

All communications-related error codes are ER2 error codes, that is they are not considered cause for a shutdown of the 942 unit itself. There is always a communications error code generated when a <NAK> character is sent under the ANSI X3.28. With XON/XOFF flow control error codes may be generated, but there will be no standard indication of this fact.

User Responsibility

All of the previous commands are available on all models of the Series 942 that have communications capability. It is the responsibility of the user to refrain from altering parameters which may not appear on the unit. (Example: A<u>X</u>LO should not be set to 1 or 2 if the unit is not equipped with alarm outputs.)

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Notes

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